Characteristics of Common Feed Grains

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Differences between grains in feeding value are often a reflection of starch content, rate and extent of starch digestion in the rumen, and how completely the starch is digested by the animal. A large part of the differences in starch digestion between grains can be explained by differences in processing. Grains prone to shattering during processing result in more fines, more rapid rates of digestion, and potentially more digestive problems accompanied by low and/or fluctuating feed intake.

Table 1. Average Nutrient Composition of Grains, Dry Matter Basis.

Grain	Crude Protein %	Starch %	DE[a] Mcal/kg	ADF[b] %	Ruminal Starch Digestion % Total Starch[c]
Corn	10.3	75.7	4.1	3	65
Barley	12.7	64.3	3.7	7	87
Wheat	15.9	70.3	3.9	8	89
Rye	11.8	65.0	3.7	8	90
Triticale	15.7	67.0	3.7	8	90
Oats	11.6	58.1	3.4	16	92

[a] *Digestible Energy*
[b] *Acid Detergent Fibre*
[c] *All grains were steam rolled, except corn which was cracked.*

Information on protein levels, DE, and ADF were compiled from references [1, 2,] and [3].

Corn

Corn is the most common feed grain in North America and is the standard to which all other grains are compared. Corn contains the highest level of starch and energy of the grains discussed and has the lowest percent of ruminal starch digestion (Table 1). These characteristics make it a good source of energy for cattle.

Corn protein (zein), which is fairly resistant to degradation by the rumen microbes, encapsulates the starch granules resulting in the slower rate of starch digestion as well as more ‘bypass´ protein. This extra bypass protein does not necessarily result in superior performance. With a lower protein content, corn based rations usually require supplemental degradable protein that may not be required with grains typically fed in Alberta.

Barley

Relative to corn, barley contains less energy with greater ruminal starch digestion. Although the rapid rate of starch digestion can result in more digestive problems, this negative feeding attribute can at least partially be offset by the more complete total digestion of the starch [6, 7]
similar levels of protein being absorbed by the animal despite the higher bypass value of corn protein [7, 8].

As is often the case for grains with high rumen digestibilities, barley fed cattle often have lower feed intake [10,11] and occasionally reduced gains, but similar, or even improved feed efficiencies [9,10,11] compared to corn fed cattle. Comparable performance with corn and barley fed cattle despite the lower energy in barley, is likely a result of the more complete starch digestion of the barley with higher microbial protein production.

Wheat

Hard red wheats are more prone to shattering during processing, which results in more fines and increased potential for digestive problems. The rapid starch digestion is not only due to the fines resulting from processing, but to the natural characteristics of the wheat protein and starch [12].

When fines can be controlled, wheat can be a valuable feed grain due to its high energy and protein content. In a summary of 30 trials comparing wheat to corn, wheat fed cattle ate an average of 9% less but with an equal improvement in feed efficiency [10]. In an 18 trial summary that compared wheat to barley, gain was similar but there was a 10% average improvement in feed efficiency with the wheat [10]. These relative feeding values comparing wheat with barley and corn are consistent with a more recent review of the literature [15].

Rye

There is little documented research comparing rye to other grains. Like wheat, rye is more susceptible to shattering during processing than is barley. Although rye´s energy content is similar to barley, the extra fines with processing likely results in a lower relative feed value. With lower average protein content, the potential increased need for protein supplementation must also be considered as rye replaces barley in the ration.

At least part of the palatability concerns expressed by people who have fed high levels of rye, are likely a reflection of lower intakes resulting from the digestive problems associated with feeding highly digestible grains. Rye is susceptible to ergot; a fungal disease that can develop when flowering is disrupted by environmental stresses. Toxicity problems, which can range from reduced performance to gangrene, sloughing of tails and hoofs and even death, can occur when the ration dry matter contains over 0.1% ergot bodies by weight. Ergot must be considered when feeding rye to livestock.

Not only is barley higher in protein than corn, the higher level of ruminal starch digestion results in more microbial protein production. This extra microbial protein produced usually results in

Triticale

As with wheat, feeding triticale is often associated with lower intakes, moderately reduced gains, but with improved feed efficiency and energy retention compared with grains of slower rumen degradabilities [5, 13, 14]. The higher protein level of triticale can also be of value when supplemental protein is required. Triticale is also susceptible to ergot (see comments on rye).

Oats

Oats are often considered to be easier to feed than other grains. This is likely due to a lower energy content with a little more of its energy coming from fat, rather than to a slower rate of starch digestion [6]. In other words, oats are likely not much easier to feed than an energy equivalent amount of barley. Performance of cattle finished with oats is surprisingly similar to cattle finished with barley [15]. With the lower energy and higher fibre content of oats (Table 1), slightly less forage will be required in a finishing ration containing high levels of oats.

As with corn and rye, cost of a potential increase in protein supplementation must be considered as oats replace barley in the ration.

Summary

Grains other than barley are occasionally less expensive per unit of energy and become attractive for use in feedlot rations. Grains such as wheat and triticale are moderately higher in energy than barley, but are more challenging to feed at high levels due to more fines and faster rates of starch digestion. The greater ruminal starch digestion associated with feeding these grains is usually accompanied with lower intakes, possibly reduced gains, but with improved feed efficiencies compared to cattle fed barley.

In backgrounding rations, these grains can make up the majority of the grain portion without digestive problems. Although these grains have successfully made up the total grain portion of finishing rations, they are usually blended at levels (20% - 50% of the grain) that moderate potential differences in performance and minimize digestive problems as indicated by low and/or fluctuating feed intake. When price disparities are large, increasing the forage content will allow higher inclusion rates of wheat, rye and triticale while minimizing digestive problems.

When ration protein levels are near minimum requirements, cost of additional protein supplementation, or savings with reduced protein supplementation must be considered as alternative grains replace barley in the ration.

Take Home Message

***** Grains are an excellent source of energy, a good source of protein, and a fair source of all the minerals
except calcium.

***** Differences in protein content between grains are hard to evaluate economically as supplemental protein
is often not required and varies with protein content of the forage and the growth rate of cattle.

***** There are only minor differences in mineral and vitamin content between grains.

***** This paper focuses primarily on the differences in energy content, digestion, and utilization.

References

1. *Suileiman, Abdullatif I. H. 1995. Ten Year Average Analysis of Alberta Feeds. Alberta Agriculture.*
2. *National Research Council. 1984. Nutrient Requirements of Beef Cattle.*
3. *National Research Council. 1989. Nutrient Requirements of Dairy Cattle.*
4. *Nocek & Tamminga. 1991. Site of Digestion of Starch in the Gastro-intestinal tract of Dairy Cows and its Effect on Milk Yield and Composition. J. Dairy Sci. 74:3598-3629.*
5. *Hill & Utley. 1989. Digestibility, Protein Metabolism and Ruminal Degradation of Beagle 82 Triticale and Kline Barley fed in corn - based cattle diets. J. of Anim. Sci. 67:1793.*
6. *Herrera-Saldana et al. 1990. Dry Matter, Crude Protein, and Starch Degradability of Five Cereal Grains. J. Dairy Sci. 73:2386-2393.*
7. *Spicer et al. 1986. Ruminal and Post-Ruminal Utilization of Nitrogen and Starch from Sorghum grain-, corn-, and barley-based Diets by Beef Steers. J. Anim. Sci. 62:521.*
8. *Feng et al. 1995. Effect of Barley Variety and Dietary Content on Digestive Function in Beef Steers Fed Grass Hay-Based Diets. J. Anim. Sci. 73:3476-3484.*
9. *Beauchemin et al. 1996. Effects of Fibrolytic Enzymes in Corn and Barleybased diets on performance and carcass characteristics of Feedlot Cattle. Proc. (Abstracts) Can. Soc. of Anim. Sci. p. 13.*
10. *Brethour, J. R. 1966. Feeding Wheat to Beef Cattle. Kansas Agricultural Experiment Station, Hays Kansas. Bulletin 487.*
11. *Milner et al. 1995. Effects of Barley Variety or Corn on Feedlot Performance and Feeding Behaviour. Proc. West. Sec. Amer. Soc. Anim. Sci. 46: 539-542.*
12. *McAllister et al. 1990. A Study of the Sequential Digestion of Barley, Corn, Sorghum and Wheat by Rumen Microorganisms. Can. J. Anim. Sci. 70:571-579.*
13. *Lorenz, Klause. 1982. Triticale Processing and Utilization: Comparison with other Cereal Grains. In: Ivan A. Wolf (Ed.), CRC Handbook of Processing and Utilization in Agriculture. Volume II: Part 2, Plant Products. p. 277. CRC Press, Boca Raton, FL.*
14. *Zinn & Garrett. 1984. Net Energy Values from Steam rolled Triticale and Steam Flaked Corn. Proc. West. Sec. Amer. Soc. Anim. Sci. 35:264.*
15. *Owens & Gill. 1995. Impact of Grain Sources and Grain Processing on Feed Intake by and Performance of Feedlot Cattle. Proc. Symp. Intake by Feedlot Cattle. Oklahoma Ag. Exp. Stn.*